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ARTICLE I.

"THROUGH DRAINAGE" IN THE TREATMENT OF OPEN WOUNDS.

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A VERDICT, almost unanimous, has been pronounced in favour of Mr. Lister's antiseptic method of treatment of wounds. In a practical point of view it is conceded to be an advance so great and so valuable that it is not easy to find its parallel even among the amazing strides of modern surgery. This favourable verdict has not been arrived at by the overshadowing influence of a great name, nor has it grown out of the teachings of a popular school of medical thought, nor indeed is it merely the result of a general acquiescence in a fashionable theory. It is the expression of the results of a fair and honest trial of the method by men of all schools and in all parts of the civilized world; a trial which, on Mr. Lister's earliest announcement of his views, was begun by a few earnest men with many doubts and with much hesitation; but a trial in which each succeeding witness confirmed the favourable testimony of those who had spoken before him, until, at the present moment, it would hardly be extravagant to assert that there are fewer men who do not acknowledge the practical advantages of Lister's method of treating wounds, than there are who do not recognize the usefulness of splints in the treatment of fractures, or of the ligature in the arrest of hemorrhage. This unanimity, moreover, was not arrived at on the earliest experiences of the method, nor were the first trials in every case satisfactory, certainly not convincing. It has grown out of a large experience by competent men who have, after careful study, finally been convinced by what they have seen, and speak therefore of what they know. The indorsement of the leading surgeons in every capital in Europe is enough to establish a practice, of the results of which they would be accepted as competent judges.

The verdict, thus unanimous as to the practical merits of the antiseptic treatment, is by no means so unhesitating as to the various theoretical points upon which, according to Mr. Lister, the treatment is founded, and by which its success is sought to be explained. Many men in many countries have felt and do still feel much doubt about accepting all the theoretical explanations which Mr. Lister has given as the justification of his process, and some not inconsiderable names can be cited who differ from him fundamentally as to theory, and yet are perhaps among the most zealous advocates of his plan as a surgical procedure.

Mr. Lister himself is exceedingly unyielding on this point. For him the theory so perfectly explains the practice, and the practice so admirably justifies the theory, that nothing is wanting but a rigid adherence to his rules, and scrupulous care in carrying out details in their application to secure the hoped-for results; and, when these results do not quite correspond with the expectations of the surgeon, it is not the method or the theory that is at fault, but it is the careless or imperfect application which, according to the theory, cannot, if properly applied, fail to secure all that has been promised. This somewhat exacting demand should be carefully borne in mind while studying this subject, and we must remember that we are obliged to believe all that Mr. Lister believes, and to do all that he commands, or we shall fail to secure the promised blessing. This Mr. Lister does not hesitate to avow, and this absolute submission of the details of the practice to the requirements of the theory is the leading feature in all his teachings and the ready explanation of all apparent failures in the result of his practice.

We are called upon to believe, for example, that bacteria of every dangerous form are floating abundantly in every, even the purest and most wholesome, atmosphere. We are also asked to believe that these germs, if once allowed to come in contact with a wound or sore, have the power not only of causing putrefaction of the fluids, but of entering into the tissues of the affected part, and, having made a lodgment there, have the power of reproduction to such an extent that they rapidly pervade the whole exposed region, and spread their ravages to the mass of the blood, and finally, we are taught, and the lesson is insisted on with great earnestness, that this is the cause and the only cause of all the septic accidents to which the wound is liable. These three postulates are the fundamental and essential features of the whole system, and, if it can be shown that any one of them is not true, then we must not only give up the theory as untenable, but we must supply the place of the exploded doctrine by an explanation which will not only account for the acknowledged success of the practice, but which cannot in its turn be discredited or disproved.

And here it may with great propriety be asked, if the practice be so avowedly successful, and if the theory be a sufficient and not unreasonable explanation of the phenomena of its application, why raise a question about the soundness of the speculative views, the practical results being by all acknowledged to be entirely satisfactory? The reasons for thus impugning a theory which, in one sense, answers its purpose sufficiently well, are in my judgment many and good. In the first place, science should never be incumbered with false doctrines, even though these doctrines do not apparently lead to objectionable practice. In the second place, though false theory may not in the particular case involve bad practice, yet, when, believing in the false theory, we extend it to other practical applications perhaps widely different from that with which we commenced our study, it will be sure to land us upon unsound conclusions and upon unsafe practice. Once more, sound practice based upon sound theory leads to new advances and new achievements in our art. Experience, be it ever so extensive, is never and can never be fruitful if it be not founded on accurate science; and the man who piles up through years of perhaps tolerably successful practice, an experience in which the reason why he succeeded and the reason why he failed have never been clear to his own mind, finishes his professional course not a better, but often a much worse practitioner than he was when he began his blundering career. For these and other good reasons it seems to me to be a clear duty to sift thoroughly, and, if truth demands, to set aside the theoretical claims which Mr. Lister has put forward as to the foundations of his so-called antiseptic treatment of wounds.

In pursuance of this investigation then we are entitled to ask: *First.* Is there no other explanation of the ill-behaviour of wounds beside that offered by putrefaction and the absorption of putrid materials into the blood?

Secondly. Are there no agencies which modify the tendencies to ill-behaviour in wounds besides those that prevent putrefaction?

Thirdly. Are all the details insisted upon by Mr. Lister necessary to secure the favourable result?

Fourthly. Is it true that if all the precautions required are carefully and thoroughly taken we may be absolutely sure of success?

These are general questions it is true, but they cover the whole subject of theoretical and practical antiseptic surgery. If these questions must be answered as Mr. Lister would answer them, then the whole discussion is closed, without any chance of reconsideration or appeal, and, in the surgery of wounds, we must hereafter accept without hesitation or doubt all that Mr. Lister directs us to believe as well as all that he directs us to do. If, on the other hand, it should appear that any or all these questions admit of any other answer than that demanded by the septic theory, then it is competent to us to propound and maintain any other view, which to us may seem well founded, which will explain the *modus operandi* as well as account for the success of Mr. Lister's treatment. My own judgment has long been made up that the first and second of these questions admit of an affirmative answer, and that the other two should be answered in the negative. Let us consider each question in order.

First. *Is there no other explanation of the ill-behaviour of wounds besides that offered by putrefaction and the absorption of putrid materials into the blood?* The points here at issue may be somewhat narrowed by excluding at once all general or constitutional conditions. All must allow that an ill condition of the general system must modify the local actions unfavourably; while all would agree that the wounds and injuries most likely to behave well would be those occurring in a vigorous and healthy constitution. We may confine ourselves therefore, in studying this question, to the local actions set up by the traumatism, and the question might then be modified so as to read, Are there no local influences affecting the wound unfavourably besides those resulting from putrid absorption? This question is evidently a vital one, testing not merely the correctness of Mr. Lister's theories, but the extent of their application, for it must be observed that he does not claim that bacteria are sometimes, but that they are always and exclusively the agents of evil symptoms in the wound, and that upon this extent to which the theory is carried depends alone the significance of his practical precepts.

In trying to arrive at the answer to this question, let us begin with a distinct recognition of the facts with which we are to deal. The first and chief fact in the case is that in a given wound we sometimes see instead of a healthy process of repair, that inflammation is developed with its various consequences in the shape of suppuration, ulceration, and mortification. The second most important fact is that when these destructive consequences of inflammation are once established in the wound, we have the whole system in some way involved in the disturbance, and that this involvement of the general system is usually somewhat nearly proportioned to the gravity of the local mischief. These are the chief conditions of a wound to which we apply the term ill behaviour, and these are the facts in the history of wounds, in reference to which all our present speculations must be made to correspond. The advocates of the germ theory say that these germs are always floating in the atmosphere, and finding access to the wound, produce their appropriate effect, namely, putrefaction of the secretions on its surface, and that these putrid secretions poison the tissues with which they come in contact and irritate them to the degree of inflammation. Furthermore, they contend that the septic germs not only irritate the surface of the wound, but that they enter into the circulation, and that thus their poisonous influence reaches beyond the surface of the wound, affecting the neighbouring parts, and finally, by poisoning the whole mass of the blood, produce those general or constitutional commotions, which accompany the local disorder.

It is no part of my present business to attack the germ theory as such. Indeed, I may as well say at once, that I am a firm believer in many of its most important doctrines, but the affirmative answer to our question claims that it is the only cause of wound accidents, and it is this exclusive claim which I refuse to acknowledge. Let us look at the facts in the history of traumatisms a little more largely. Inflammation and its consequences are the mode in which wound accidents almost exclusively show themselves. Now, can nothing determine inflammation except the irritation of putrid secretions? As I regard the pathology of wounds and injuries, inflammation is a disturbed and morbid course of a process, which should be one of simple repair. I recognize the universal law that every tissual lesion calls forth a certain, appropriate, and generally sufficient amount of reparative action. If the reparative disposition finds favouring conditions its work is promptly, perfectly, and safely accomplished; if, however, the circumstances be not favourable, then the process of repair is apt to be complicated by the disordered actions which we call inflammation. In some of the lower classes of animals this reparative action is never other than a purely physiological process. Perfect repair and even entire reproduction of lost parts occur uncomplicated by any morbid process, and as far as we can observe, without any marked interference with the vigor or well-being of the injured individual. This perfect repair becomes less complete and more often complicated with disordered or excessive action as we rise in the animal series, till, when we arrive at man, we have repair so constantly complicated with excessive action that the very process of repair itself is by many confounded with its most deadly enemy, and we commonly speak of healing by adhesive inflammation, and by suppurative inflammation, as if such inflammation were not, in its own nature, the great obstacle to the healing process, which process can never be completed till the inflammation disappears.

Inflammation being thus prone to complicate the reparative nisus in the human body, and being the greatest if not the only factor in the evil behaviour of wounds, we may ask, Are there no conditions which produce inflammation in a recently inflicted or in a healing wound, besides those depending on septic influences? I consider that there are several, perhaps many. First, the condition in which the parts are left by the injury, contused, lacerated, irritated by foreign substances, over-heated or over-chilled, has much to do with their power of maintaining the reparative effort, certain to be called forth by the injury, and restraining it within physiological bounds. If by any of these, or similar causes, the nerve power of these injured particles has been so lowered that they cannot, in the impending reparative nisus, maintain the balance of the excited reparative forces, then physiological activity becomes pathological excess, and the reparative nisus is converted by a transition all too easy into inflammatory disintegration. Again, let us suppose that the vital depression of the injured tissues has been still greater, and that in the reaction which must follow some particles are not able to bear the sudden rush of blood upon them, which the reparative actions require, and still less able to endure the strain, which commencing inflammatory action puts upon them, will not death of particles (necrobiosis of Virchow) be sure to take place, and, occurring in the midst of tissues already struggling against the onset of disease, decide the conflict in favour of that destructive process of which it is itself the cause and the representation? Once more, given the same circumstances, and as a direct consequence of vital depression in the most severely injured parts of the tissues, we may have, as every day's experience shows us, death in mass, sloughing, mortification, greatly hindering the regular course of the reparative action, and precipitating in the adjacent parts that inflammatory excess which is so utterly inimical to healthy repair.

These wound conditions which I have presented as examples are, I contend, in their origin and essence independent of anything like septic influences. I recognize fully that these conditions, once fully produced in an injured part, are, by the very tendency they show towards inflammation, extremely prone to lead to the formation of poisonous fluids by the absorption of which the inflammation may be intensified and extended to the surrounding parts, and to the general system. But it seems to me perfectly evident that the first cause of these vicious actions is something anterior to and independent of putrefaction, something which produces a poisonous change in the fluids of the part, not something which is itself produced by the irritation of their poisonous contact; something in short which is not the result of putrefaction, and which may, and, as I believe, does constantly exist where putrefaction has never been suspected.

The above are given as examples of local conditions of injured parts capable of determining inflammatory accidents, which appear to be in their nature and origin entirely independent of poisonous absorption. Let us now look at some of the instances in which distant parts are involved in the local mischief, and inquire if all these distant disturbances must be explained by a poison circulating in the blood. And here, perhaps, I ought again to avow my full belief in the doctrine of blood infection as explaining many cases of distant disorder dependent upon local injury. The question before us is simply, Is this blood-poisoning the only explanation which science can offer, and must it be applied in all cases? Let us look, for example, at those injuries in which pain in distant and uninjured parts, either immediate and constant, or secondary and paroxysmal, constitutes the chief complaint of the sufferer. Let us examine the pathology of those cases where, instead of mere pain, sympathetic as we say of the original injury, we have those more serious commotions of the general system, neuralgias, convulsions, tetanus, and ask if none of these can be explained in any other way than by referring them to a poison circulating in the blood.

Let us still more carefully note those cases, and they are not a few, in which reparative action has seemed to be normal from the commencement to the end; when, perhaps, abundant suppuration has been of a healthy character throughout, and free from all suspicion of putrefaction; when granulation has been vigorous and sound, and has afforded from the outset the most perfect protection possible against absorption of all kinds, and yet, in which, if the reparative demand be greater than the system is able to sustain, we have progressive emaciation, loss of digestive power, increasing weakness, delirium at night, diarrhœa uncontrollable by remedies, and finally all the symptoms fully developed of true hectic. When we have carefully watched such a case reduced gradually to the lowest stage of exhaustion, and then behold the effect of a sudden removal of the offending cause, as by the amputation of the suffering member, how, as it were, the storm which was previously raging, at once becomes a calm, how delirium ceases, how healthy function returns, sleep becomes refreshing, digestion nourishing, and healthy repair of the amputation wound is promptly and cheerfully undertaken by a constitution which seemed only to ask to be relieved of a part of its burden to be able to deal vigorously and successfully with the rest; I ask, and I have no doubt as to the correct answer, Is the explanation of all these distant sympathies to be found only in the existence of a poisonous virus circulating in the blood?

May it not be that there is in the nervous system a capacity of being excited by and of suffering with a local injury which may afford a plausible and reasonable explanation of at least some of the cases of traumatism in which the process of repair is turned into a morbid rather than into a healthful direction? This sympathetic action of the nervous system, illustrated, as it is, by so many brilliant modern discoveries, is an old-fashioned doctrine, a doctrine sanctified by the teachings of Hunter, Travers, Cooper, Brodie, a doctrine which modern research amply justifies, and which explains many things which in my judgment are simply inexplicable on the absorption theory. Is it wise to shut our eyes to every pathological suggestion but that which explains all forms of fever, and every accident of inflammation by septic absorption? Is it wise to ignore altogether the influence of nerve condition as the starting-point of wound accidents? Is it wise, in short, and to return to my original query, to reject every other explanation of the success of Mr. Lister's practice except that which we derive from Mr. Lister's theory?

This brings us naturally to the consideration of the second question propounded, viz.: *Are there no agencies which modify the tendency to ill-behaviour in wounds besides those which prevent putrefaction?* The answer to this question clearly depends upon the answer given to question number one. If, as I have attempted to show, there are causes, other than septic influences, which may act unfavourably on wounds, then the agents which may control these other causes would fairly come within the purview of this second question. And first let it be fairly understood that inflammation following injury, with all its possible disastrous consequences, is recognized by all to be the most constant and the most important factor in the morbid conditions now under consideration. Inflammation, uncontrolled, produces the suppurations, ulcerations, sloughings, which so often give the fatal character to wounds which were originally reparable. Inflammation delays healing, multiplies suffering, exhausts vital power, and in short, is the great adversary which we have to combat from the beginning to the end of our treatment of severe injuries. From the large importance accorded by all to this process of inflammation, this second question might fairly resolve itself into this: Are there any agencies which will control the tendency to inflammation in wounded parts? Mr. Lister claims to absolutely prevent it by excluding the germs upon which it depends as its cause; our question is simply can we control it? The answer of modern therapeutics would be, I think, unhesitatingly in the affirmative.

Leaving out of consideration at present all those indirect influences of which every careful surgeon gladly avails himself, as rest, position, food, medication, regimen, etc., I contend that there are certain agencies which act directly, locally, and at times powerfully in controlling or even in arresting inflammation. Of these agencies I recognize chiefly three, viz., cold, local bloodletting, and the action of certain drugs. Of the first two I have no occasion here to speak particularly. No surgeon who has witnessed the effect of ice bags applied to an inflamed joint, and no physician who is familiar with the effects on peritoneal inflammation attained by the cold pack on the Kibbee cot, can have any doubt about the efficiency of cold in controlling inflammation; and it is certainly unnecessary to cite any illustration of the value of bloodletting under the same circumstances. Of the last class of agencies which control inflammation I wish to speak more in detail; and for brevity's sake I will confine my remarks to one single drug, viz., carbolic acid. The testimony as to the singular power which this drug possesses of controlling inflammation is derived from various sources, and bears upon cases of inflammation attacking mucous and cutaneous surfaces, traumatisms and granulating wounds. Some of this testimony is popular, and some is scientific. As to the popular judgment, I doubt if any remedy in the Dispensatory has established in the popular mind a more positive and distinct character as a queller of inflammation than this drug carbolic acid; as witness the universality of its use in all conditions and all stages of inflammation of the throat, nares, urethra, bladder, and generally to all those mucous membranes to which it can be easily applied, or rather perhaps to those to which its application can be easily regulated. And, moreover, I have the belief that if the popular mind were not so exclusively occupied with the action of carbolic acid as an antiseptic, we would more distinctly and more frequently recognize its marvellous power of controlling inflammation in the immense number of inflammatory conditions to which it is now so indiscriminately applied. Probably it is from a similar pre-occupation of the attention among scientific observers, that I find so few utterances bearing upon this point from men whose opinion would be authoritative. Going back, however, to the year 1860 we find Lemaire, who was one of the earliest writers on phenic acid, struck with the effects of this substance on the well-being of wounds, causing them, as he says, to clear off rapidly, to granulate actively, and to heal promptly. Lionel Beale in his "Disease Germs" says: "The true explanation of the undoubtedly beneficial action of the carbolic acid antiseptic treatment may be very different from the explanation offered by Mr. Lister. To me it appears much more probable that the carbolic acid acts directly upon the growth and multiplication of the bioplasm of the part." Mr. J. R. Wolfe, in the *Med. Times and Gazette*, Nov. 25, 1865, says: "As far as my experiments have gone I am satisfied with its beneficial results. It causes a healthy granulating surface counteracting the tendency to hyperplasia and suppuration." Alex. McCrae, writing in the *British Medical Journal*, 1872, says of carbolic acid: "By its use pain is decreased or becomes altogether nil; excessive granulations are arrested; unwholesome discharges are checked, bad odours are dispelled; the tendency to destruction of tissue is replaced by a proclivity to heal." These observations were recorded before the antiseptic properties of carbolic acid were made so prominent as they now are, and when, therefore, the exclusion of germs was not provided for. They show, therefore, the impressions of the writers as to the beneficial action of the drug on inflamed tissues without regard to its action as a germ destroyer.

How carbolic acid acts in producing its peculiar effects has not by any means been distinctly ascertained, and, perhaps, as is the case with many of our most efficient medicines, its *modus operandi* may never be perfectly understood. Something, however, may, I think, be learned in this direction by observing its effects on healthy mucous and cutaneous surfaces exposed for a length of time to its moderate influence. Take, for example, the effect on the adjacent parts when the spray has been kept playing upon them during a prolonged operation; or, what perhaps comes nearer to our own experience, the effect on the hands of the operator of this same spray during a long operation. The effect is benumbing, and if very long continued, almost paralyzing to the nerves of sensation. This to me is a suggestive fact. If the moderate application of carbolic acid through the unbroken cuticle produces so evident an effect on the nerves distributed under it, may we not fairly suppose that when applied directly to wounded surfaces the same kind of benumbing and paralyzing effect may be exercised more powerfully on the nerves which are here exposed naked to its influence?

It is not, I think, a strained or unfair inference, that the continuance of this action may have some retarding effect upon the vital actions which, whether for repair or disease, are excited by the very existence of the traumatism. I have myself felt very strongly that just here we are touching upon a most important feature in the explanation of the results of Mr. Lister's successful treatment of wounds. My attention once directed to this point, I think I have verified this power, which I claim that carbolic acid possesses, of modifying vital actions in many striking instances. I have watched commencing surface inflammations rapidly diminish and disappear under carbolic dressing when no exclusion of germs was attempted. I have seen wounds of all kinds and degrees of severity go through their stages of repair without a trace of inflammatory complication, and even when inflammatory complication had not been prevented. I have seen the morbid actions which threatened infinite mischief so modified and controlled by carbolic acid constantly applied as to be practically robbed of their usual power to inflict damage. These things I have seen when no thought of germs or their exclusion was in our minds, in so many cases and so constantly repeated that I have come to believe that this peculiar virtue of carbolic acid is the true and sole explanation of the success not merely of Mr. Lister's practice, but of that of many other able observers who have agreed with Mr. Lister only in one thing, viz., that they have kept their wound surfaces constantly under the influence of carbolic acid.

Some common cause is necessary in order to explain the acknowledged success of those who, in every country in Europe, as well as in our own, have deviated more or less widely from Mr. Lister's requirements; and this common cause is, as far as I can learn, to be found in the use in every case of the carbolic acid, more or less carefully, and more or less constantly applied.

In corroboration of the views above given as to the power of carbolic acid in controlling inflammation, let me state that many of our wounds treated by this drug not only showed no trace of inflammation, but what was much more striking, and what forced itself on the attention of those who were watching the cases with me, ceased to show the ordinary evidences of repair, and remained passive and unchanging from day to day, so that it almost seemed as if all vital action in the affected tissues was suspended or destroyed. This has been so marked, and has so pressed itself on our attention, that early in our studies we became convinced that there was a point in every case when the continued use of carbolic acid began to hinder or to prevent repair, and it has been a matter of careful study to ascertain, as nearly as possible, exactly at what point the application ceased to be merely antiphlogistic, and became anti-reparative. I feel quite sure that this point can be approximatively ascertained in every case, and most happily we have felt pretty well assured that when this anti-reparative action of the remedy begins to show itself distinctly, its antiphlogistic influence has ceased to be important, and still more that its antiseptic powers are no longer required.

A still further corroboration of the depressing power of carbolic acid is found in those cases which have been reported in which its too free use has produced direct and immediate death of the exposed surfaces. I find one such case reported by Mr. Ollier, of Lyons, in the *Bulletin de Thérapeutique*, 1872. It was a child, æt. 13, who had, after a slight splinter wound of finger, dipped the part in strong solution of carbolic acid, and afterwards dressed it with the same. The next day, when seen by Mr. Ollier, the finger was dead, and in due time separated in the usual manner. Dr. Tillaux, of the Hospital St. Antoine, reports in the same journal, in a previous year, two similar cases, where a saturated solution produced gangrene in one case of a finger, and in another of some toes. We have at this moment in the hospital a man in whom, for a slight ulcer on the foot, a strong solution of the acid had been applied by a druggist outside, in whom much inflammation, or rather excoriation and vesication of the skin had taken place; but at one point where the acid had been most thoroughly applied about the ulcer, there was a space of four square inches over which the integument was dry and dead, as though burned with a hot iron, so dry and bloodless that it seemed perfectly certain that a process of death could not have been preceded by any inflammatory condition, but was the immediate effect of depressing power of the agent employed.

I do not pretend to claim that the facts, and opinions, and suggestions which I have thus presented prove positively my assumption as to the controlling power of carbolic acid; but I do claim that they make a case not unreasonable or improbable, and one which challenges further attention mainly because it explains, better than any other assumption, the facts which have now so largely accumulated through the extensive employment over the civilized world of this curious, interesting, and, as I believe, most valuable drug.

The third question propounded is, Are all Lister's details necessary? This question has its interest chiefly in the fact that some of these details are onerous, some are expensive, some are useless, and some are positively injurious if we do not find their justification in the absolute requirements of the case. Thus, for example, the application of a full Lister dressing demands a great deal more care, and a great deal more time, than an ordinary dressing. It can rarely be committed to an assistant, the surgeon himself being required at least to be present at and superintend each of the earlier dressings, if not to conduct them with his own hand. This is a tax which every conscientious surgeon would willingly pay for such great benefits as Mr. Lister promises to his diligence and his devotion; but at the same time, if all this time and all this personal attention be not necessary to success, the sooner we know it the sooner we shall be released from a tax which is intolerable if it cannot be shown to be inevitable. In the same way, the expense of the materials used would be little thought of, if the cost could be shown to be no greater than was absolutely necessary. In private practice, even among the poor, where usually single individuals and single cases are concerned, this matter of expense does not assume so much importance as it does in those large institutions, sometimes poorly enough endowed, where great numbers require surgical treatment, and where the difference between the old and the new methods of dressing involves a very large increase of outlay, when sometimes such increase can with difficulty be afforded. Again, if by any modification of theoretical view, any part of these multitudinous details can be shown to be useless, it is greatly desirable to be freed from the useless part. Thus, in the minds of a great number of good and careful observers there has arisen a doubt as to the usefulness of the spray, and many are convinced that, without abandoning any part of the original theory, there is good warrant for omitting the spray altogether, as not necessary in securing all protection which Mr. Lister's theory calls for against germs and their fatal effects upon wound surfaces. Once more, some of the appliances insisted on are positively injurious, and should be left out if not absolutely necessary. Of these injurious features we have the over-heating of the parts by piling so thick and so heavy dressings, the sweating and maceration of the surfaces covered over so largely by impervious layers of protective and Mackintosh; and last, and not least, the retention in and about the wound not only of the discharges from the sore, but also of the atmosphere which, under the close confinement, must be constantly charged with all the impurities which are generated during the progress of its cure. If, now, any of these onerous, expensive, useless, or injurious details are not clearly essential; if success can be achieved by measures less laborious, less expensive, useless, or injurious, I contend that it is of the highest importance that these unnecessary details be intelligently modified or altogether omitted.

The fact that some, at least, of these details are unnecessary would appear from two kinds of proof. 1. Theoretical. 2. Statistical. Of theories there are two which, if accepted, would render some of these details unnecessary. First, that which entirely rejects the view that atmospheric germs are the prime agents in producing surgical accidents; and second, that which, accepting in full the prevalence and evil influence of these atmospheric germs, considers that their evil influence may be counteracted by less energetic and less minutely careful opposition than the full Lister method demands. With the first perhaps we need not now stay to deal. So indisputable is the evidence in favour of atmospheric germs being the cause, directly or indirectly, of certain septic accidents, that we may fairly acknowledge that where any intelligent doubt exists upon this point, it is rather a doubt as to the extent and directness of germ action, and not by any means a rejection in toto of the influence of these germs. Leaving, then, this theoretic view for the present, let us look for a moment at that which accepts the germ theory in its fullest extent, and yet which holds that all Mr. Lister's minute prescriptions are not necessary to obviate their evil effects. These observers contend that bacteria have not, or at least have not been proved to have, such astounding power in penetrating and permeating all surfaces, whether natural or traumatic, in such an incredibly short space of time, that if vigilance be relaxed but for a moment, if but a small corner of the defensive works be left unguarded, so that a corporal's guard of these deadly enemies, which are keeping such vigilant watch for their opportunity, can gain admission, the battle is lost and the citadel captured. They contend that by careful and constant use of germicides on the exposed surfaces, the fatal particles can be in part kept out and in part slaughtered in the breach, or even within the walls, with the same certainty and success with which a few straggling assailants, getting entrance into a well-garrisoned fortress, would be dealt with, provided the main body of the besiegers were successfully held in check. If to these ideas we add, that a very large number of the best minds in the surgical profession have great doubt as to the efficacy of the spray, as commonly used, as in itself a germicide,[1] and who believe that freely applied to the exposed surfaces, either in aqueous or oily solution, the carbolic acid is all-sufficient for the protective duty assigned to it, I have presented, as far as is necessary for my present purpose, the views of those who do not regard all Mr. Lister's minute details of treatment as in all cases necessary.

But secondly, the test of experience—the experimentum crucis—may be invoked in the settlement of these questions. The limits of this article forbid my going into statistical detail. It is well known that Mr. Lister has never published any full statistics of his results. Until he does we have nothing with which to compare our own. Suffice it here to say, that as compared with the published results of his followers, we can show results achieved by surgeons who have departed from Mr. Lister's instructions, which are so excellent as to challenge the superiority of the original over its modifications. These published results are now numerous and authoritative, and offered by men of first rank as observers and careful reporters. I would like to bring together a large number of such witnesses to support my views, as I could easily do; but shall content myself with presenting my own experience, which has now become, from my opportunities in the Roosevelt and in the New York Hospital, sufficiently extensive to give it some weight in the discussion of the points at issue.

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[1] See a valuable article on this subject by Dr. L. A. Stimson in the January No. of this Journal.

I began soon after Lister's views were announced by treating all cases of severe injury, and all operation wounds, strictly according to his plan, and with a degree of success which was eminently satisfactory. Doubts as to the necessity of the spray soon presented themselves. It was left off—all other Lister precautions being retained—and with results which seemed equally good. Hearing of Ranke's experiments with thymol, I, with some of my colleagues, tried it in numerous cases, both in private practice and in hospitals. So many doubtful and so many disastrous results presented themselves that we soon began to distrust and before long to abandon the drug altogether. This clinical experience with the thymol first turned my thoughts towards the idea that it might not be the antiseptic virtue of either carbolic acid or thymol which was the most important or valuable in the treatment of wounds, for both these agents were conceded to be potent germicides, and of the two perhaps thymol had been shown to be the most powerful; and yet here were a series of cases where, with equal care in their employment, the better germicide failed to give as good results as the feebler one. This seemed naturally to suggest that there might be some property about carbolic acid besides its power of destroying germs, which gave it in practice a decided superiority over its then much-praised rival. This superiority I soon came to believe arose from a power to control all vital actions, and among them conspicuously those which partake of the nature of inflammation. It is upon this idea that I have been pondering and experimenting during the last two years, and it is the result of these lucubrations that I have proposed to set forth in this paper.

The fourth question proposed, viz.: Will strict adherence to Mr. Lister's details secure invariable success? I do not propose to discuss. I rather introduced the query to emphasize the statement that such invariable success is claimed for the antiseptic method. I do not assert that Mr. Lister has, in so many words, claimed for his method an absolute certainty of result; but no one can doubt that the general tenor of his teaching, and that of the enthusiastic apostles of his views and promulgators of his doctrines, would plainly indicate that they at least believed in such certainty. And truly the doctrine, if true, demands a uniformly successful result, and a single positive exception would be sufficient to overturn the whole theory. One single case in which perfect antiseptic treatment did not protect the patient from septic accident, would be a fatal blow to the soundness of antiseptic theories, and accordingly such exceptions are not admitted, and they are ruled out under the specious plea that where accidents do occur during the course of antiseptic treatment, these accidents are due, not to any fault of the principle, but to a failure in its application, and that some carelessness or haste, or other imperfection in the mode of applying the dressings, has left some loophole open through which disease germs have entered, and that thus success has been prevented.

To this, of course, we have no reply to offer, except that, in the hands of others, failure has occasionally attended the most careful Lister treatment, where the most diligent and candid search could not detect the slightest flaw in the completeness and accuracy of the compliance with Mr. Lister's requirements.

I confess I do not think that all these interesting and important questions connected with the antiseptic method can at present be definitely settled, and that perhaps it is wiser to decide that statistics show for the Lister treatment a much larger proportion of success than can be claimed for any method preceding his discovery; but that as yet it is not clearly shown that his method is so superior to all the modifications of it that have been and are now being tried, as to vindicate its somewhat arrogant pretensions to be the true and only gospel of the surgery of wounds.

These preliminary considerations I have thought necessary to make, in order to present intelligibly the real subject of my paper. This real subject is in fact a report of a method of treatment of wounds and injuries which I have adopted during my last ten months of almost continuous service in the New York Hospital, to which I have been led by the reasonings presented in these preliminary remarks, and which, while it differs *toto cœlo* from Mr. Lister's plan, has been attended with a success which seemed to me to warrant a reconsideration of the whole matter of the so-called antiseptic treatment of wounds.

The plan itself consists in the free and constant use of appropriate solutions of carbolic acid. in water, no care being taken to keep the wound shut off from the influence of the atmosphere, and provision being made for the inner surface and cavities of the wound being constantly, or at least frequently, moistened by the carbolic acid solution. This is the outline of the plan, but its details can perhaps be best presented by describing its application to a case, to which case, fully described in all its details a little further on, I must for the present refer the reader.

To those who have taken the trouble to read carefully the considerations presented in the previous pages of this communication, the prominent idea presented in this method of treatment will be easily appreciable. The idea underlying the whole series of experiments, for such I am willing to consider them, is that by controlling the tendency to inflammation by the use of carbolic acid, applied constantly and in an effective way to the injured surfaces, we can obviate the dangers to which, in the process of repair, these wounds are liable, and that the success of the treatment will be in direct proportion to the degree of control which, by that method, we are able to secure. This has been the leading idea in my mind during all my study of the cases I am about to recount; and while I acknowledge that they are not numerous enough to definitely establish my theoretical views, yet I do feel that when such results as I have to report follow a method of treatment, based entirely on the antiphlogistic idea, and excluding entirely the antiseptic view, I have a right to challenge the attention of those who believe in nothing but sepsis and its results, and at least to demand a comparison of methods, on a scale large enough to be authoritative.

The cases now to be reported have not been selected. They embrace all the wounds or open injuries which were not so extensive as to prove fatal within a few hours, or so slight as not to admit of special dressings, which were received into the hospital during the ten months embraced in the report, as well as every operation considerable enough to give an opportunity for the use of the new method. A certain proportion of them therefore were wounds made in operation, some in opening formidable abscesses, some by machinery, some by falls variously injuring the soft parts, and some, and by far the most interesting to us, were compound fractures of the bones. In these latter injuries it commonly happened that a considerable time had elapsed from the moment of receiving the injury to the time of the patient's coming under treatment, an interval abundantly sufficient, if Mr. Lister's views of the activity and industry of atmospheric germs be correct, to have determined a fatal inflammation in every one of them. The report is founded on the results of the treatment of all these cases, all being subjected to the same method, the chief difference among them being in the length of time which had elapsed before they were brought under treatment.

CASE I.—Jas. N. G., a vigorous and healthy man, æt. 35, was admitted to the New York Hospital April 13, 1879. About a year before his admission I had been called to see him with a dislocation of the astragalus, which after faithful endeavour, I had been unable to reduce completely. He got about with the deformed limb after a time, but found walking difficult and painful, and to make matters worse, inflammation and abscess occurred on the most prominent point of the displaced bone, which was followed by exposure and caries of the denuded surfaces. Under these circumstances, with the concurrence of my colleagues, I removed the astragalus on the 17th of May. There was nothing noteworthy about the operation, except that the bone was very rigidly fixed in its new position, requiring a great deal of force to dislodge it, and excepting also that when the bone was at last removed the deformity was not overcome till the external malleolus had been removed to the extent of nearly three-quarters of an inch. This gave a fair control of the foot, and it could now be brought into a promising position. A splint had been prepared, consisting of a plaster of Paris casing extending from the knee nearly to the ankle and attached to a foot-piece by two broad straps of brass which went wide of the ankle-joint as they passed to support the foot-piece. By this arrangement the foot was held steady while by the divergence of the brass straps easy access could be had to every part of the ankle-joint, so that the dressings of the wound could be applied and removed without any movement of the foot of the wounded ankle. The wound, which consisted of a semilunar incision extending from behind and below the internal malleolus in a curved line over the dorsum of the tarsus to the external malleolus, was dressed by bringing the edges together with carbolized silk sutures, a long drainage-tube having first been passed across the deeper part of the wound from one malleolus to the other. This tube had been prepared so that the part within the wound had been perforated with a number of holes, care being taken that all that part of the tube which projected from the wound should be free from openings. The wound was then covered with the ordinary prepared carbolized gauze laid on in three or four thicknesses, first being well wetted with one-fortieth solution of carbolic acid, and so arranged upon the surface of the wound that the ends of the drainage-tube were free as they projected on either side. This we generally accomplished by cutting holes in the dressing opposite the points of entrance and exit of the drainage-tube, though sometimes the tubes could be brought out between the folded pieces of which the dressing was composed. This retained in position by a few turns of the thin gauze bandage also wetted with carbolic acid solution completed the dressing. The limb was then suspended from a framework so that it was raised about six inches from the bed, and swung easily from side to side on every motion of the patient's body. This arrangement was found extremely comfortable, and permitted the drainage from the wound to be freely discharged from the lower opening. Four times a day a solution of one-fortieth carbolic acid was thrown through the drainage-tube with an ordinary syringe, and continued till the fluid discharged at the lower opening was perfectly clear. The result of this manipulation was that the fluid forced by the syringe into the upper end of the tube found its way freely into the cavity of the wound, distending it and then found its way out at the lower orifice carrying with it all the fluid secretions which otherwise would have been more or less confined within the wound. This distension of the wound by the injected fluid would not of course happen to any great extent if the whole tube including its lower orifice were free from obstruction, but it very often happened that the outlet was impeded by plugs of dried pus or by clots and then the penetration of the fluid to all the recesses of the wound was very complete—a penetration which we considered so desirable that sometimes the lower orifice of the tube was pinched by the finger and thumb, while the injection was being made, for the express purpose of securing it.

The accompanying illustrations will explain the mode of placing the drainage-tubes in various wounds, and the manner in which they are brought through the completed dressings. Fig. 1 shows the tubes as they are ordinarily placed in a compound fracture of the leg. Whenever the laceration of the deeper parts brings the wound near to the integument on the opposite side of the limb, a counter-opening is made and the tube passed through the limb either between the broken fragments or in close proximity with them. When, however, the injury of soft parts is confined mainly to the tissues between the broken bone and the external wound, then the tube is passed down to the fracture and brought out at a little distance from the point of entrance, as seen in Fig. 2. This figure also shows the usual mode of dressing of compound fractures with a strong plaster casing with a large fenestra opposite the wound. In a case like that represented at Fig. 1, when the tubes traverse the limb another fenestra is made at the point of their exit. The wound exposed in the fenestra is lightly dressed with carbolized gauze through which the tubes are allowed to protrude from one to two inches. Fig. 3 shows the completed dressing of a very bad case of compound fracture of the elbow-joint.

Fig. 1.

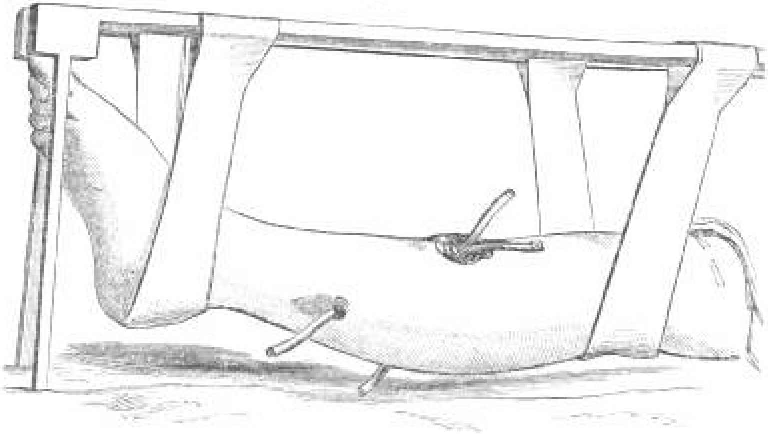
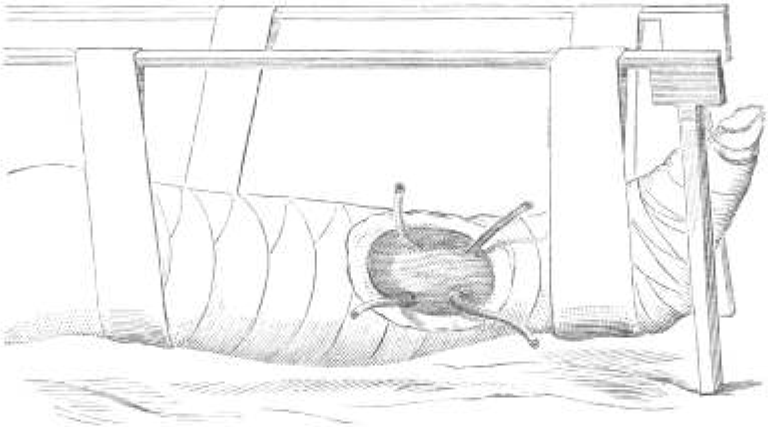


Fig. 2.

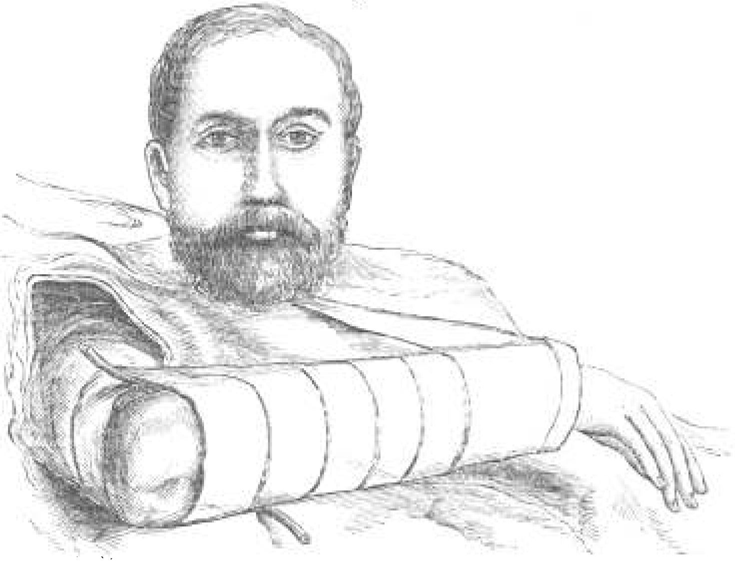


The tube traversed the opened joint and projected above and below the dressings, as shown in the cut.

In this way the discharges were prevented from accumulating in the case we are relating, or even from staining the dressings, and the wound was treated with the greatest possible comfort to the patient, and almost without a complaint of pain after the first day or two succeeding the operation.

His temperature card here annexed (Case II. of the general list) shows that the thermometer never was above 100°, and that during almost the entire period of treatment it was not far from the normal point. His appetite was undisturbed, his spirits perfect, his sleep very rarely interfered with. In short he passed through the whole period of treatment in a condition as near normal, and with as few signs of local or constitutional disturbance, as any man could do, while completing the repair of so large and formidable a wound as that necessarily caused by the excision of the astragalus. The wound gave no sign of inflammation; no pus at any time dropped from the end of the tube, and the injected fluid was commonly returned only slightly turbid at first, soon becoming perfectly clear. No smell could at any time be detected about the wound, and the staining of the dressings was evidently due more to the injection than to the discharge. The progress seemed so perfectly favourable, the wound so free from complaint, and the dressings so clean, that we allowed the original dressings to remain, watching from day to day for an indication to change it, until the thirteenth day, when curiosity rather than a conviction of necessity induced us to inspect the wound. This was done on the 9th of May. We found but little indication of retained discharge, the edges of the wound clean and free from any evidence of inflammation, and about one-third of the wound firmly adherent. Round the points of exit and entrance of the drainage-tube there was no inflammation, and the part of the wound which gaped slightly was covered by a well-formed layer of granulations. The sore was washed with a one-twentieth solution of carbolic acid, and dressed as before. A few days after, finding everything in *statu quo*, the tube was removed, and though the wound was washed daily with carbolic acid solution, some being injected into the sinus, this was soon given up, and the parts dressed solely with Peruvian ointment.

Fig. 3.



Under this the wound healed rapidly, and he was discharged from the hospital June 25, with a good, and we have reason to hope, a useful joint.

CASE II.—Was one of Syme's amputation; performed for gangrene of the toes. The patient H. L. was a healthy man of 35 years, who had had his foot caught between a tightening hawser and the deck, crushing the metatarsal region severely. This was two weeks before his arrival at the hospital, and gangrene of the injured parts had already proceeded so far as to render amputation the only resource. Syme's method was adopted and carried out in the usual manner on the 17th of April, 1879. Two drainage tubes were introduced from the two sides of the incision, and brought out through a buttonhole cut for the purpose in the posterior part of the flap. The rest of the dressing, after a sufficient number of sutures to hold the flap firmly in place, was made by a few folds of Lister's gauze moistened with carbolic solution, and held in place by a few turns of bandage. No protective was used, and no Mackintosh, and the dressing merely covered the wound without extending more than a couple of inches from it in any direction. These outer dressings were occasionally wetted with the carbolic solution, and the same was injected through the tubes three or four times a day, the leg being suspended so that the lower orifice of the tubes should always be clear. The progress of the case was as favourable as possible in all respects. Some sloughing of the flap took place along its edges, but the centre adhered well, and the margins granulated and healed as soon as the sloughs had separated. Though the sloughy material was retained in contact with the tissues, and necessarily shut up in the dressings during many days, yet no signs of inflammation showed themselves, no evidences of systemic or local blood-poisoning, and no constitutional disturbance of any importance during the whole course of the case. The temperature never rose above 101°, and that only on one day. Most of the time it was below 100°. The tubes were removed on the 8th of May, and the parts dressed with balsam of Peru. On the 2d of June the record shows the wound healing rapidly, and on the 22d he was discharged, with an excellent stump.

CASE III.—Was one of secondary amputation of the leg for compound dislocation of the ankle. The original injury was treated strictly by the Lister method, but did badly; sloughing took place to a considerable extent, and laying bare large surfaces of the bones made a cure impossible. He was a man near sixty, not a very vigorous specimen, and constitutional irritation soon became very threatening with delirium, stupor, high temperature, and rapid failing of strength. Convinced that a large part of his constitutional suffering was sympathetic, I proceeded to amputate, with approval of my colleagues, in the midst of these most unfavourable conditions. At this time the temperature varied from 100° to 103°; his stupid delirium alternated with paroxysms of violent mania, and everything indicated the most profound involvement of the nervous system. The operation was performed in the usual manner, low down in the leg, with lateral skin flaps. This was done March 13th, and the wound dressed, with a single drainage tube, in the same manner as above described. As showing that his symptoms at the time of operation depended more upon pressure upon the nervous system than upon blood poisoning, I may note that within a few hours after amputation the whole aspect of affairs was changed; his night was one of refreshing sleep, and his delirium had given place to a quiet and comfortable intelligence. Next morning he was more nearly in a natural condition than he had been for many previous days. The wound did not behave particularly well, the flaps separated a good deal, and soon sloughing took place. The wound was kept as sweet as a sloughing wound could be by frequent injections through the tube, and most of the time very comfortable, a condition which seemed to the patient so clearly produced by the injection that he frequently asked for it when the wound was paining him, and always expressed relief from its application. No local inflammation, and no constitutional disturbance appeared during the progress of the cure; the temperature never rising above 100°. The tube was removed on the 22d, and the wound dressed with balsam of Peru. Slowly but steadily the wound healed; and he was discharged cured, with a very promising stump, May 6, 1879.

CASE IV.—Mrs. T., æt. 37, was admitted to the hospital March 26, 1879, with necrosis of the humerus, occupying the middle third of the bone. On the next day an operation was performed by which several sequestra were removed from points so far distant from each other that though the whole amount of dead bone removed was not large, yet the involucrum had to be chiselled away to so great an extent that a gaping chasm, seven inches in length, was left on the outer and anterior face of the arm, when the operation was completed. This wound was dressed as heretofore described, with one drainage tube running obliquely through the deepest part of the wound. Advantage was taken of one of the fistulous tracks to bring out the end of the tube from the posterior surface of the arm, thus securing a dependent opening while the patient was lying down. The arm was supported on a pillow to keep the lower orifice of the tube free. The progress of the case was uninterrupted. She suffered no pain, and she had no signs of local inflammation or general fever. Scarce any discharge of pus showed itself, and in fact the dressings were so entirely free from odour and from soiling that we allowed them to remain untouched until April 10th, when the wound was dressed for the first time, just two weeks from the day of operation. It was found so well filled in by granulation, and healing so healthfully, that the drainage tube was removed and simple dressing applied. She was allowed to return home on the 16th April, with the wound very rapidly improving.

The next three cases were bad lacerated wounds without fracture of bones.

CASE V.—L. S., æt. 55, came into the New York Hospital May 16, 1879, with a very extensive wound of arm, caused by thrusting it through a pane of glass. The tissues were largely and deeply cut in various directions, making a very formidable wound. He was received about four hours after the injury, and was dressed at once on the through-drainage plan, two tubes passing across the deepest portion of the wound. Everything was perfectly quiet during the healing, and free from inflammatory complication. The tubes were removed on the 1st and 2d of June, and he was discharged cured on the 10th.

CASE VI.—M. K., æt. 22, was brought in May 23d, having been struck by a falling iron shutter, which had inflicted a severe lacerated wound on the thigh. The surface wound was only about three inches in length, but upward and forwards a deep pocket was formed at least six inches in extent. This very dangerous wound was dressed in the usual manner, and in order to secure through drainage a counter opening was made opposite the most dependent part of the wound for the emergence of the lower end of the tube. No complication or interruption presented itself during the progress of cure. June 2d the tubes were removed, and June 26th he was discharged cured.

CASE VII.—J. M., æt. 24, admitted June 9, 1879, with a bad lacerated wound of arm on its posterior surface, just above the elbow-joint, caused by being run over by a truck. Two surface wounds, each about two inches long, existed, but were accompanied by much laceration of the deeper tissues, and, of course, by great contusion. The condition of this wound rendered inflammation and sloughing exceedingly probable, but under the through-drainage dressing not a bad symptom showed itself, and he was discharged cured June 20th.

CASE VIII.—This was a case of cold abscess on the side of the thorax, which did not seem to depend upon any disease of the rib or of the lung, and which had been slowly increasing for about two years. The patient was a man of thirty, and in other respects he appeared to be well. He had had little or no pain in the swelling, which was rather abruptly prominent from the surface, elongated in form, six inches in length, firm to the feel, so that it had been considered a tumour, and its removal advised. It was opened April 15, and four ounces of pus evacuated. A drainage tube was then passed through the length of the abscess, emerging at its most depending point. No other dressing was necessary. The cavity was injected several times each day, and filled up without a symptom of inflammatory reaction. On the 21st the tube was removed, and on the 24th he was discharged, against my advice, but apparently well.

The remaining cases are all examples of compound fracture, a class of injuries in which I have thought that the through-drainage system offered some peculiar and very great advantages. They are always anxious cases, often dangerous, not unfrequently fatal. Every hospital surgeon knows how important and how alarming are all symptoms of inflammation in open fractures. How much of the fatality to limb or life depends upon an extensive suppuration; how much the chances of good recovery are diminished, if, at any point, the inflammation reaches the stage of gangrene; how prone the morbid action, once lighted up at the seat of the injury, is to spread in all directions, compromising life as much by its extent as by its severity, no one can fail to have noticed who has had even a limited experience in these always serious cases. I think that the testimony of all the best men who have tried it would be that the practical results of Mr. Lister's method in the treatment of compound fractures have been eminently satisfactory. In our own experience in this city it has been a revolution, so uniform and so striking have been our favourable results. It is now comparatively a rare thing for us to be disappointed in our attempts to save a limb which has undergone this injury, provided there has been a reasonable ground to found our hopes upon; and indeed I cannot but fear that our confidence of success leads us sometimes to save limbs by the Lister treatment, which in old times would have been amputated, which are utterly useless when saved. Twice I have been obliged to remove limbs which I had thus saved, because their condition, when entirely healed, was so hopeless and helpless that their owner asked to be relieved from their encumbrance. This broad fact of the eminently successful treatment of open fractures by Lister's method seems to me very suggestive, and to demand a moment's notice in passing from the bearing it has upon Mr. Lister's theory. We acknowledge that open fractures behave well under Lister's treatment, and yet they present conditions very different from those which Mr. Lister demands as essential to success. They are wounds always left open to the access of atmospheric germs for hours, sometimes for days, before they are protected by the dressings. They are deep, involving many tissues in injuries which unfit them for good repair. They are irregular in form, and generally so situated as to be incapable of full drainage by ordinary methods, and yet they do wonderfully well provided inflammation have not, by delay, gained too strong a hold. This seems to me a pregnant fact; and when accepted as a clinical result on a large and authoritative scale, it seems very much like an absolute demonstration that the access of atmospheric germs to a wound surface is not always nor in all cases so fatal to success as Mr. Lister so uniformly and so strenuously maintains. I must confess I have sometimes wondered when I have seen my zealous friends going through all the pomp and circumstance of spray and protective at each dressing of a compound fracture, involving perhaps five minutes of exposure, when I remember that the wound was originally exposed to the poisonous action of the atmosphere for twenty-four hours, or perhaps longer. I earnestly commend this thought to my candid readers, and ask them to say if compound fractures, which are exposed for hours before treatment is commenced, do not behave worse than operation wounds made under spray, where is the clinical justification of that troublesome and disagreeable, and, as I believe, utterly useless part of the proceeding.

And here, perhaps, I ought to present a feature in which I think the through-drainage method in compound fractures presents a great advantage over the full Lister dressing. Mr. Lister requires a large surface round the wound to be covered by his carbolized gauze and the protective Mackintosh to guard against the dreaded germs creeping in under the edges of the dressing, and thus gaining access to the wound. This large surface, covered by thick and heavy dressings, interferes very greatly with the application and effective action of the necessary splints, which, of course, must be put on outside of the dressing. The splints, thus put on, conceal the dressings so that it is not possible properly to watch their condition; and moreover, and what is much more important, they have to be removed entirely every time the wound is dressed. This handling of a compound fracture when its supporting splints are removed, is always a disaster; and one of the greatest modern improvements in the art of treating fractures is found in the various contrivances by which we now succeed in maintaining firm support while necessary changes are being made. I cannot myself see any way to obviate this cardinal difficulty, if we must adhere to Mr. Lister's large dressings. In the through-drainage method of dressing, this difficulty does not occur. The compound fractures are put up as soon as may be in the plaster-of-Paris splint, with large fenestræ cut opposite the wounds. The small surface about the wound which is thus exposed is dressed with about four thicknesses of unprepared gauze dipped in a solution of carbolic acid one to forty. The drainage tubes are brought through holes cut in the gauze, and then a gauze bandage, similarly wet, is placed round the splint to keep everything in place. No protective is used, and no Mackintosh. Occasionally the dressings are wetted with the carbolic solution, usually at the time when the wound is syringed as above described. This dressing is renewed as often as may be necessary, but of course without any movement of the fractured bone, the splint being untouched; and from the perfect manner in which the discharges are constantly being removed, the changes of dressing are comparatively rare.

Another point which should be made here has reference to the drainage tubes. As ordinarily used, pushed down to the bottom of the wound, and just emerging from its surface, with no counter opening to permit the emptying of the cavity, and with the external orifice closed by the contact of the dressing, they answer their purpose imperfectly enough. But when in addition to these unfavourable conditions we have the orifice of the tube pressed on by the splints, which must be bound somewhat firmly over the dressing in order to support the fracture, we have a mechanical arrangement which does not seem to me well adapted to favour the escape of fluids from the recesses of the wound. Indeed, the value of a drainage tube ought to depend upon the completeness with which it will drain; and tubes arranged as they usually are will certainly not drain a wound with the same thoroughness as they would if left with both orifices wide open, as they always must be in the method I am now advocating. This arrangement of the drainage tubes is, of course, the cardinal feature of my plan, and by it are secured two elements of success of prime value, viz., the free and perfect evacuation of all noxious fluids from the wound, and the easy and thorough admission of the carbolic solution to its every crevice and corner. That the admission of atmospheric germs through the open mouths of the tubes has not been injurious is pretty strongly indicated by the success of the practice, and the uniform testimony of the patient has been that the injection of carbolized fluid has been grateful and comforting; so much so that in a great many cases the patients would send for the house surgeon, saying that their wounds were beginning to feel uncomfortable, and asking to have the injection performed for their relief. Some anxiety has naturally arisen in our minds as to the dangers of carbolic acid poisoning, and we have, of course, watched with some apprehension for the appearance of symptoms indicating its toxic action. Nothing of the kind has presented itself; no patient has shown the first suspicious symptoms. I do not underrate the danger, but I think it is one common to all instances in which carbolic acid is largely used, and I feel quite confident that by reason of the limited cutaneous surface exposed to the acid solution, as well as by the perfect evacuation of the injected fluids, we have less to fear from carbolic acid poisoning in cases treated by the through-drainage plan, than in those treated according to the regular Lister method. All these points will, however, be better illustrated by the cases I am now to relate:—

CASE IX.—Julia A., æt. 25, was brought in April 28, 1879, with a compound fracture of the leg received from a fall about an hour before admission. The fracture was in the lower third, very oblique, not much comminuted, and the wound small, about two inches above the ankle-joint. The wound was enlarged and the tissues about the ends of the bones were found to be very much lacerated, so that the finger passed into the wound reached nearly to the skin on the opposite side of the limb. At this deepest part of the wound counter-openings were made, and two drainage tubes were introduced, running close to and partly between the ends of the fragments. Small and light carbolized gauze dressings were applied, and the tubes brought through in the usual manner. A plaster-of-Paris splint was then applied to the limb, encasing it from the toes to the knee, and in this, as soon as it was dry, fenestræ were cut opposite the original wound, and opposite the points of exit of the drainage tubes, through which fenestræ the dressings could be watched, and changed whenever necessary without disturbing the fracture. The treatment was thenceforward conducted precisely as in the other cases reported, and the progress was so favourable that the dressings were not changed for more than a week. On the 9th of May, the wound granulating finely, the tubes were taken out, and the wound dressed with balsam of Peru. On the 18th of June, good union having been secured, the splints were removed. Two small necrosed fragments of bone came away before the wound finally healed, and she was discharged cured October 6, 1879.

CASE X.—W. L., æt. 55, admitted June 13th. His right arm had been caught between an elevator rope and the drum, causing severe injury of the elbow-joint. The whole joint was deeply contused, and a large irregular wound led down to a fracture of the internal condyle of the humerus, and it was thought also that the coronoid process of the ulna was broken off. The wound communicated with the elbow-joint, which was largely opened on its posterior and inner aspect. This very formidable and unpromising wound was first washed very thoroughly with carbolic acid solution 1 to 20, and then the gaping edges brought together with a few stitches, after passing a drainage tube across the wounded joint, so arranged that it would drain the whole track of the wound. Light dressings being then applied, the limb was placed at a right angle in a tin guttered splint, with a proper opening for the emergence of the drainage tubes. The patient maintained his general condition surprisingly, no manifest constitutional reaction following. The local behaviour was equally favourable. The wound was dressed on the 16th, and showed no signs of inflammation, a considerable part of the skin wounds having united. From this time he was dressed about twice a week, and at no time was there any free purulent discharge. The injections were made three or four times a day as in the other cases, and though the fluid must necessarily have found free access to the joint, there was never any indication of synovial inflammation. The final results were extremely satisfactory, and he was discharged cured August 19, 1879.

CASE XI. was very similar to the last. J. C., æt. 52, was injured in the right elbow by the wheel of a railway car from which he fell while it was in motion, though it was not certain that the wheel passed over the limb. He was admitted May 30, 1879, and examination revealed several lacerated and contused wounds about the region of the elbow, one of which opened into the joint. A portion of the internal condyle was broken off and removed. Two tubes were inserted into the wounds and brought out through dependent counter-openings, and the limb, dressed as above described, was supported in an angular tin splint. This wound did not behave locally quite as well as the last reported. Some sloughing of bruised integument took place, but without any serious inflammatory threatening. The sloughs soon cleared off, the wounds granulated well and healed soundly without any bad symptom on the part of the wounded joint, and he was discharged cured August 15, 1879.

CASE XII.—This case was one of very severe injury, and presents several points of such interest that I shall give it with some fulness of detail. Jas. D———, æt. 16, was brought to the hospital May 13, 1879, having fallen through an elevator shaft or hatchway. He fell through six stories, striking, however, on several projecting points on his way down sufficiently to break in some degree the velocity of his descent, and possibly thereby to save his life. His injuries were a simple fracture of the right humerus, a bad compound fracture of left humerus about its middle, and a fracture of the left fibula, which was not discovered at the time of his first examination. The most serious feature of his condition, however, and that which held his life in peril for many days, was the great depression of all the powers produced by the tremendous concussion to which his body had been subjected. This showed itself in a pulse so feeble that it could barely be perceived, habitually very frequent, and also in a heart beat that could scarcely be distinguished by the hand laid over it, and with heart sounds so faint and feeble that at times they were almost imperceptible. With this there was a feeble voice, imperfect inspiration, unwillingness, almost incapacity, for any muscular exertion, and a pallor of surface which, as it was most marked in the face, gave the impression that he was constantly on the eve of fainting. There was no paralysis, however, and fortunately no indication of concussion or compression of the brain. The wound on the left arm was very extensive, running in an irregular line about five inches along the inner and anterior aspect of the arm, at some points closely approaching the brachial artery. Owing to his extreme prostration, which had, no doubt, been much aggravated by loss of blood, we were content to lay the broken arms in as good condition as might be on pillows, the compound fracture being thoroughly washed with a 1 to 20 carbolic acid solution. Two drainage tubes were introduced through the deepest portions of the wounds, emerging at counter-openings made at dependent points. The pillows were arranged so that the lower ends of the tubes were free, and jute was placed under them to catch the discharge. By the utmost care, and the most watchful nursing, and the intelligent use of food and stimulants, reaction became gradually established, and by the 17th his condition seemed to warrant an attempt to put the compound fracture into proper supporting splints. A tin angular splint with fenestra for the drainage tubes was prepared, and we proceeded to move the limb, carefully to place it upon the splint, when a gush of blood was noticed from the wound, evidently from a large artery. Grasping the arm above the wound the brachial was easily controlled, and no further hemorrhage occurred. This gave us a chance quietly to explore the wound, and it was soon discovered that the brachial, where it lay exposed in the wound, had been eroded, presenting a smooth oval opening, communicating largely with the cavity of the vessel. The artery, which was very accessible along a considerable part of the wound, was bared above and below the opening, and securely tied at both points, when, of course, all anxiety with regard to hemorrhage was at an end. From the position and smoothness of the erosion I suspected that the trouble might have been caused by the pressure of the drainage tube, as it crossed the course of the artery, and this point I thought desirable to settle positively. The tubes had been taken out in the hurried movements which followed the hemorrhage, and the position of parts had necessarily been disturbed while seeking for its source. The tubes I carefully replaced, and placing the limb as nearly as possible in the position in which it had lain before the bleeding, it was immediately evident to all that the lower tube, which passed directly across the artery, had pressed upon the vessel so that the beating of the artery against the elastic tube had gradually caused the erosion which finally produced the hemorrhage. This was to me a unique experience in the use of drainage tubes, but the practical importance of the fact seemed to make it proper that it should be circumstantially recorded. Of course, it is possible that such an accident might happen whenever a drainage tube comes in contact with a large artery, but I take much comfort in believing that the peculiarly depressed condition of my patient's reparative forces made the accident possible in his particular case, while there need be but little apprehension of its occurrence in the ordinary use of these most valuable surgical appliances. The occurrence, however, suggests caution and care.

The limb was placed upon the splint which had been prepared for it, the drainage-tubes were replaced, and the wound dressed in our usual way. No further accidents occurred in the arms. The favourable progress of the case was slow but steady. The wound granulated well, and, after the tubes were removed and the wound dressed with balsam, coaptation splints were applied. The wound finally healed without necrosis, and good union was obtained.

While these things were going on in the arm, mischief was brewing below. The left leg, of which he had made but little complaint, began to swell and to be painful, and fluctuation was soon discovered, and six ounces of pus evacuated from the outer aspect of the leg, just below its middle. Much relief followed this discharge, and a drainage-tube was passed into the abscess and out by a dependent counter-opening. Deep trouble was still going on, however, and in a few days afterwards another opening was made on the posterior aspect of the limb, again evacuating a good deal of pus. This opening was so situated that the drainage-tube could be brought through it, thus draining the whole track. This was done, and the wound from that point made favourable progress. The probe, however, passed into the opening detected bare bone. By certain movements of the foot and lower part of the leg crepitus could be elicited, and it soon became evident that the fibula had been broken about a hand's breadth above the ankle. This was the starting-point of the suppurative action, which in its turn had prevented or delayed the process of repair in the broken bone. This seemed worthy of record, as presenting an example of that very unusual course of a simple fracture, where it becomes compound by exciting suppuration about the point of injury. It is but right to say that in this case the extreme prostration of the vital forces during the first ten days after the accident may fairly be held to explain much of ill-behaviour of the wounds even in a late stage of their progress. The final result was perfect recovery without necrosis, though the cure was, as it might be expected to be, tedious and prolonged. He was discharged cured, October 31st.

These cases are all that I think it necessary to recite in illustration of the methods of through drainage and of the general behaviour of wounds and injuries treated under this system. They seem to me to show very conclusively that absolute exclusion of atmospheric germs is not necessary to the successful treatment of these accidents, and, taken in connection with the large experience of other observers who have treated their cases by the more or less constant and thorough application of carbolic acid, they very strongly confirm my conviction that the real element of success lies in the peculiar power which this drug has of controlling and modifying vital actions. This conviction I unhesitatingly avow, and most confidently entertain. I wish it, however, to be distinctly understood that the proposed plan of treatment does not stand justified by this theoretical view alone. It may very well be that the antiseptic powers of carbolic acid are the valuable, and perhaps the only valuable, influences which are to be recognized in the successful results obtained. It may be that the constant presence of the acid on the surfaces of wounds and in the discharges from them, does, by prevention of putrefaction, prevent inflammation and its disastrous consequences. Even if this view be insisted on, and putrefaction be acknowledged as the sole and universal cause of wound accidents, then, I think, that this application of carbolic acid is as effectual in preventing putrefaction as Mr. Lister's most elaborate dressing can be, and that this constant antiseptic action can be secured by less troublesome and less cumbersome apparatus than that which Mr. Lister demands.

Whichever theoretical view prevails, however, I venture to believe that the plan here offered will be found most effective and most convenient and most reliable of the different methods of treating wounds by the constant application of carbolic acid to their surfaces.

I give below a tabular statement of all the cases treated by through drainage during ten months' service. As I could not burden my communication with details of so many cases, I have thought that a fair general idea of the work done would be gained by a simple list of the cases, with their temperature tables as recorded during the first ten days of treatment. If to this I add that every case went through its successive stages without inflammation at any time sufficient to defeat repair, and that in every case the result was equal to the best attained in the most favourable instances of the given traumatism; that few abscesses were met with, and none of the character of diffused suppuration; that no compound fractures failed to unite, and that in only a small number was there any necrosis of the ends of the fragments, I have given the chief facts which are important in the history of the most satisfactory series of surgical cases which have ever fallen under my observation. I do not offer them as statistics from which any safe deductions may be drawn; but I feel that, occurring, as they have done, under the supervision of one observer, in one institution, at one period of time, and embracing all the cases which, in that period of time, were suitable for the treatment, they have at least established a claim for careful consideration, and fairly justify a trial of a method which, though in a narrow sphere, has given such uniformly successful results.

No. 1.—H. O. T., æt. 37. Extensive necrosis of humerus; *sequestrotomy*. Temperatures 102, 100, 99°; never rose above normal.

No. 2.—E. S., æt. 53. *Compound dislocation of thumb* and *laceration of hand*. Temp. 100, 102, 100, 103, 100, 100, 98, 103, 98°.

No. 3.—J. C., æt. 52. *Compound fracture of humerus*, opening elbow-joint. Temp. 101, 101, 102, 101, 101, 101, 99°.

No. 4.—W. E. J., æt. 30. *Cold abscess* opened and evacuated. Temp, 100, 99, 100°; no further rise.

No. 5.—H. J., æt. 45. *Fibroma of gluteal region* removed. Temp. 99, 99, 98, 98°; no further rise.

No. 6.—J. Q., æt. 60. *Amputation of leg*, lower third. Temp. 98, 100, 99, 99°; no further rise.

No. 7.—P. Q., æt. 55. *Chisel wound of knee-joint*. Temp. 100, 98, 99°; varying from abscesses forming—final cure.

No. 8.—J. D., æt. 20. *Compound fracture of malleolus*. Temp. 100, 99, 100, 98, 98°; once afterward 102°.

No. 9.—H. L., æt. 35. *Syme's amputation* for gangrene following injury. Temp. 98, 99, 101, 99, 99, 99, 100°.

No. 10.—L. S., æt. 55. *Lacerated wound of arm*. Temp. 99, 99, 98, 98, 98°; never rose above normal.

No. 11.—J. H. G., æt. 35. *Excision of astragalus*. Temp. 99, 99, 100, 100, 99, 99, 99°.

No. 12.—M. K., æt. 22. *Extensive laceration of thigh*. Temp. 100, 98, 98°; no further rise.

No. 13.—J. M., æt. 24. *Laceration of elbow*. Temp. 102, 101, 98°; no further rise.

No. 14.—W. L., æt. 55. *Compound fracture into elbow-joint*. Temp. 99, 98, 102, 101, 102, 101°; afterwards normal.

No. 15.—A. J., æt. 27. Necrosis of femur; *sequestrotomy*. Temp. 99, 99, 101, 98°; no further rise.

No. 16.—J. A., æt. 30. *Compound fracture of leg*. Temp. 100, 101, 100, 100, 100, 100, 101, 100, 100°.

No. 17.—J. D., æt. 16. *Compound fracture of arm* and other very serious injuries. Temp. 103, 102, 104, 102, 105, 103, 102, 101, 100, 99°.

No. 18.—A. McD., æt. 60. *Compound fracture of leg*. Temp. 100, 98, 98, 99, 100, 100°; no further rise.

No. 19.—J. M., æt. 43. *Compound fracture of leg*. Temp. 101, 102, 100, 101, 101, 99, 102, 101, 100°.

No. 20.—J. S., æt. 25.—*Compound fracture of leg*. Temp. 99, 100, 98, 101, 100°; no further rise.

No. 21.—J. M., æt. 19. *Compound fracture of leg.* Temp. 100, 103 101, 101, 100, 99, 98°.

No. 22.—P. O'N., æt. 55. *Fracture of leg*, becoming compound by slough. Temp. 98, 98, 99, 99°; no further rise.

No. 23.—B. H., æt. 60. *Incised wound* of neck and of forearm. Temp. 100, 99, 99, 99, 99, 99°.

No. 24.—E. W., æt. 12. *Compound fracture of humerus*, severe lacerations. Temp. 97, 103, 101, 101, 101, 101, 100, 101, 99°.

No. 25.—A. C., æt. 15. *Lacerated wound of thigh.* Temp. 100, 101, 104, 100, 99, 99, 99, 98°.

No. 26.—J. H., æt. 31. *Compound fracture of thigh.* Death from shock in twenty-four hours. Temp. just before death, 106–3°.

No. 27.—E. C., æt. 21. *Compound fracture of metatarsus. Lisfranc's amputation.* Temp. 98, 100, 101, 102, 102, 102, 101, 100, 101, 102, 100°.

No. 28.—J. S., æt. 38. *Compound fracture of ulna.* Temp. 99, 98, 99, 98, 98, 98, 98°.

No. 29.—D. F., æt. 54. *Lacerated wound, very extensive, opening, elbow-joint.* Temp. 98, 100, 99, 98, 98, 98, 98°.

No. 30.—J. M., æt. 32. *Amputation of thigh* for arthritis of knee. Temp. 98, 99, 98, 100, 100, 99, 99, 99°.

No. 31.—M. M., æt. 44. *Compound fracture of leg.* Temp. 98, 103, 100, 102, 99, 100, 100, 100, 99°.

No. 32.—J. O'B., æt. 40. *Compound fracture of leg*, twenty-four hours without treatment. Temp. on admission, 103°; afterwards, 103, 103, 101, 103, 102, 100, 98°.

No. 33.—F. Q., æt. 21. *Amputation of forearm. Compound fracture.* Temp. 98, 100, 99, 101, 101, 101, 103, 100, 100, 99°.

No. 34.—F. B., æt. 25. *Stab wound of back*, extensive. Temp. 99, 100, 99, 98, 100, 99, 99°.

No. 35.—A. S., æt. 3. *Necrosis of femur* after compound fracture. Temp. 101, 100, 100, 99, 99, 99, 98, 98°.

No. 36.—E. M., æt. 23. *Removal lipoma of neck.* Temp. 98, 98°; never rose above normal.

No. 37.—P. S., æt. 38. *Removal of schirrus mammæ.* Temp. 100, 100, 99, 99, 99, 99, 99°.

No. 38.—M. L., æt. 20. *Compound fracture of leg.* Temp. 98, 103, 102, 102, 100, 101, 102, 100, 99°.

No. 39.—M. A., æt. 48. *Removal large tumour of thigh.* Temp. 98, 100, 99, 98, 100, 100, 99, 100, 99, 98°.

No. 40.—S. N., æt. 23. *Compound fracture of leg*, severe laceration. Temp. 101, 101, 102, 103, 102, 102, 101, 102, 101, 100°.

No. 41.—J. T., æt. 55. *Compound fracture of leg.* Temp. 98, 100, 99, 99, 99, 99, 100, 99°.

No. 42.—F. McN., æt. 43. *Large cyst of foot;* opening. Temp. 99, 100, 98, 100, 99, 99, 99, 99°.

No. 43.—G. B., æt. 24. *Removal of carious rib.* Temp. 98, 99, 98, 99, 97, 98, 98°.

No. 44.—J. K., æt. 19. *Compound fracture and dislocation of ankle-joint.* Temp. 104, 102, 102, 102, 101, 101, 99°.

No. 45.—L. S., æt. 11. *Necrosis radius; sequestrotomy.* Temp. 99, 99, 100, 99, 99, 98, 100°.

No. 46.—J. C., æt. 25. *Compound fracture of leg.* Temp. 100, 101, 101, 101, 101, 101, 100, 100°.

No. 47.—L. N., æt. 24. *Necrosis of femur; sequestrotomy.* Temp. 103, 103, 103, 100, 100, 99, 99, 99°.

No. 48.—J. F., æt. 52. *Re-amputation of thigh.* Temp. 98, 100, 101, 102, 103, 100, 100, 99°.

No. 49.—D. D., æt. 25. *Opening large cyst* of sole of foot. Temp. 98, 103, 105, 103, 103, 100°; no further rise.

No. 50.—J. D., æt. 12. *Necrosis of radius; sequestrotomy.* Temp. 100, 99, 98, 98, 98, 98, 98°.

No. 51.—J. D., æt. 40. *Compound fracture of femur.* Temp. 101, 102, 102, 102, 101, 100, 99, 100, 99°.

No. 52.—R. P., æt. 26. *Compound fracture of femur.* Temp. 100, 102, 103, 102, 102, 101°.

The result in a few of the later cases in this table there has not been time to ascertain. No case, however, has as yet presented a serious symptom.

ARTICLE II.

THE PORRO MODIFICATION OF THE CÆSAREAN OPERATION, IN CONTINENTAL EUROPE; CHRONOLOGICALLY AND ANALYTICALLY EXAMINED: SHOWING THE SUCCESS OF THE NEW METHOD; ITS ADVANCE FROM ITALY TO OTHER COUNTRIES; AND ITS DIMINISHING FATALITY UNDER A BETTER KNOWLEDGE OF THE REQUISITES FOR SECURING SUCCESS; THE WHOLE STATEMENT BEING PREPARED WITH A VIEW TO ENABLE OUR OBSTETRICAL SURGEONS TO DECIDE WHETHER WE SHOULD INTRODUCE THIS METHOD INTO THE UNITED STATES.

By ROBERT P. HARRIS, A.M., M.D., Member and Ex-President of the Philadelphia Obstetrical Society, etc.

IN the number of this Journal for October last, I presented, in the form of a review, a very imperfect and unsatisfactory record of the Porro operation, the defects of which record no one now better understands than I do myself. There is this, however, to be said as an apology—I did the best that I could at the time, and the errors that I fell into were due to the very imperfect and incorrect statistics furnished us in the accessible journals of the old world. At the time of its preparation I determined, if possible, to obtain a full tabular statement of the cases, arranged in the order of their occurrence, and giving at a glance all the important features of each individual operation, such as I had prepared on the "Cæsarean Section in the United States." It was not my purpose at the time to do this myself, but to arrange for having it done by some European writer who had already manifested an interest in the work.

With this end in view, I opened a correspondence with prominent gynæcologists on the Continent, stating the defective points in the statistics presented to the profession, and giving an outline of the tabular record I have since perfected. Instead of securing some one, as I had antici-